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New insights on the relationship between inherited structures of the opening of the Algero-Balearic basin and recent inversion of its southern margin

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The Algero-Balearic Basin (ABB) is an Oligo-Miocene back-arc basin resulting from a polyphase tectonic evolution involving Tethyan subduction retreat and bilateral slab tear propagation. The ABB was fully opened by the Tortonian, while the Gibraltar and Calabria arcs formed by the narrowing of retreating slab fragments. Since then, the Algerian margin has undergone a tectonic inversion, potentially preceding an incipient subduction as shown by the analysis of the on-offshore deformation distribution. In this work, we aim to shed light on the relationships between the large-scale structures inherited from the ABB opening and the recent margin inversion. For this purpose, we rely on two recent analyses, one addressing the ABB opening (Haidar et al., 2021) and the other mapping the inversion-related structures off-Algeria (Leffondré et al., 2021), both being constrained by a set of deep penetration multi-resolution seismic profiles cross-correlated with magnetic, gravimetric and bathymetric data.

The deep ABB has been subdivided into 4 zones with relatively distinct geodynamic evolutions, as demonstrated by variations in pre-Messinian sedimentary infill thickness and basement depth : (1) the oldest, fan-shaped oceanic basin to the east (off-Jijel), formed during the Langhian-Serravallian after collision of the Kabylian blocks with the stretched African margin; (2) the shallower and younger Hannibal thinned continental domain (HD), intruded by intense post-collisional magmatic activity during the Upper Serravallian - Lower Tortonian; and ever-younger to the west, (3) the central-western (off-Algiers-Tipaza) and (4) westernmost zones, formed from the Tortonian to the Lower Messinian in response to the westward retreat of the Gibraltar slab and the concomitant migration of the Alboran block by propagation of vertical tears along a STEP (Subduction Transform Edge Propagator) type margins.

The tectonic inversion is characterised by long-wavelength of flexure (>100km) of the ABB towards the Algerian margin and/or buckling of shorter wavelengths (≈30km). The central (HD) and central-eastern (off-Jijel) zones are dominated by flexure, whereas buckling is dominant in the central-western zone. Further, the easternmost (off-Annaba) and westernmost zones exhibit a

combination of flexure and buckling. Except in the westernmost zone, characterized by low deformation on a single fault, the margin toe consistently displays inversion-related faults systems consisting of 3 to 4 south-dipping and sub-parallel thrust faults.

By comparing the zonation of the deep ABB and the zones with different responses to inversion, we evidence a similar zonation of the margin, with only slight differences likely resulting from data density variations. To the east, the old and wide fan-shaped basin has favored the development of a significant flexural response, whereas the young westernmost zones, narrower and bordered by STEP-faults, evidence a combination of buckling and short-wavelength of flexure. The HD is a complex zone with a shorter wavelength of flexure compared to the eastern zone, probably related to magmatic activities affecting the potentially continental crust. Our results suggest that if initial zonation persists, several parameters may be involved in the control of the inversion mode. These parameters may include the opening-related structural inheritance, the oceanic lithosphere composition, as well as the age and former structures of the margin.